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ABSTRACT

This study investigates the influence of pre-instructional strategies on the relationship between learner-controlled or program-controlled length of video segments and on related test performance on post-tests and retention tests. The study looks at the effect of presenting learning objectives in advance on the learning of factual information from interactive video programs. First-year students from two agricultural colleges in the Netherlands used a computer-controlled interactive video disk about the industrial process of cheese making and completed a posttest. A retention test was administered approximately two and a half weeks later. The program had two conditions, fixed and free. In the fixed condition, subjects worked through all seven chapters in linear order. In the free condition, students could vary the order of the chapters and view parts of the video as they wished. Results show a significant result for locus of control. Subjects in the no-pre-instruction condition performed better on test items that relate to incidental learning in the pre-instruction condition than on test items that relate to intentional learning in the pre-instruction condition. Overall, program control yielded a better posttest performance than learner control, although the effect size was rather small. (Contains 20 references.) (Author/SWC)

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PRE-INSTRUCTIONAL STRATEGIES AND SEGMENT LENGTH IN INTERACTIVE VIDEO PROGRAMS

ED 409 878

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Abstract

An experiment is reported in which subjects work with an interactive videodisk program about cheese making in different experimental conditions with respect to learner control and pre-instructional strategies. The purpose of the study is to investigate the influence of pre-instructional strategies on the relationship between learner-controlled or program-controlled length of video segments and on related test performance on post-tests and retention tests. Data were collected in three rounds in April-May and December 1996, and in January 1997. The results show that program-control leads to better post test performance, although the effect size is rather small. Interaction with pre-instruction was not observed.

Pre-instruction and learning from interactive video programs

The effects of pre-instruction on learning (Hartley & Davies, 1976; Hannafin & Hughes, 1986), as well as the effects of interactive video on learning (Verhagen, 1992; Tovar & Coldevin, 1992; Schaffer & Hannafin, 1986; Phillips, Hannafin & Tripp, 1988), have been studied by several researchers. This study is an attempt to offer a contribution to the knowledge about the combination: the use of pre-instruction before working through an interactive video program.

The literature shows a variety of definitions and forms of pre-instruction (Hartley & Davies, 1976; Hannafin & Hughes, 1986). A general definition, however, is not available. In this paper, pre-instruction is conceived to offer a framework for the actual instruction. Hartley and Davies (1976) distinguish four generally accepted forms of pre-instruction: pre-tests, behavioural objectives, overviews, and advance organisers. Research shows that each of these forms is more or less suited for reaching certain learning results (Arkes, Schumacher, Gardner, 1976; Hartley & Davies, 1976).

Pre-instructional strategies, for instance, appear to be useful to support meaningful learning. The effect of different forms of pre-instruction appears to be dependent on the ability level of the learner. Learners with relatively low cognitive abilities benefit fairly significantly from overviews, for middle ability learners behavioural objectives are more suited, and high ability learners benefit more than the others from pre-tests, overviews, and advance organisers (Hartley & Davies, 1976). Derry (1984) concluded that establishing links with existing cognitive structures before instruction yielded positive effects on long-term memory of elements from a text. Research shows that orienting objectives often improve the learning process. One theory about the influence of learning objectives on the learning process is that the objectives direct the attention of the learner to relevant aspects of the subject matter (Hartley & Davies, 1976). Kaplan and Simmons (1974) concluded that a consistent relationship between learning objectives and subject matter is a necessary condition for the effect of learning objectives on learning. This implies that the objectives should cover the content to be learned. They also concluded that the use of learning objectives before the instruction leads to less incidental learning. Incidental learning is described as learning that occurs while studying subject matter to reach certain learning objectives but which is not relevant for these objectives. Intentional learning, on the contrary, is directly relevant for the related objectives. According to Gagné (1985), learning objectives help to create a mental set that directs the attention of the learner to important objectives and causes selective perception of the learning content (Klein & Pridemore, 1994).

Other researchers (Duchastel & Brown, 1974) suggest that learning objectives increase the learning of objectives-related content, but that it decreases the learning of remaining subject matter (Ho, Savenye, & Haas, 1986). Learning objectives seem not to be effective in all situations.

Research shows that presenting learning objectives facilitates the learning of factual information, but does not support learners to acquire higher cognitive skills (Hannafin, 1985; Ho, Savenye, & Haas, 1986; Mayer, 1984).

The effects of pre-instruction cannot always be clearly determined. The effects may often be overruled by powerful factors of the instruction (Mayer, 1979; Hannafin, Phillips, Rieber, Garhart, 1988). In general, the power of pre-instruction diminishes as more prior knowledge is brought to the learning situation and more structure is built into the instruction. In spite of this problem, clear indications exist that the application of pre-instruction may have

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a positive influence on learning results in certain situations.

Existing studies about the effects of interactive video and pre-instruction on learning, mainly focus on the variable 'Locus of Control'. The results appear to be inconclusive. Hannafin and Colamaio (1987), for instance, conclude that designer-controlled (the designer determines the way of sequencing and presenting of information to the learner) and learner-controlled (the learners decide for themselves which route to take through the information) conditions yield significantly better test scores than a linear condition (the information is presented in a fixed linear sequence). Tovar and Coldevin (1992), however, conclude the opposite: linear and 'mixed control' conditions scored better. In a study by Breman (Breman, 1995; Verhagen and Breman, 1995), the linear condition seems to have a positive effect on learning results that are related to the learning of factual information. An explanation could be that in the linear condition, the learners were aware of the fact that they had to watch long video segments followed by answering questions that were related to previously presented learning objectives. The awareness of the long video sequences may have stimulated the learners to invest relatively much mental effort to be able to retain the presented information.

The present study aims primarily at the effect of presenting learning objectives in advance on the learning of factual information from interactive video programs. Earlier research showed that this form of pre-instruction seems to have a positive effect on learning results (Tovar and Coldevin, 1992). This research looks at immediate recall as well as at recall over a long term. Further, the question is studied whether presenting learning objectives results in decreased incidental learning. Also 'locus of control' receives attention. Two versions of the same interactive video program, a linear version under computer control ('FIXED') and a free version under learner control ('FREE'), are used to gather more information about the influence of 'locus of control' on the learning of factual information. The experimental video disk program that is used for this study is the same that was used by Breman (1995) and Verhagen (1992).

The central research question is as follows:

> "What is the effect of presenting pre-instruction in the form of learning objectives on learning factual information from an interactive video program?"

The answer to this question is obtained by testing of the following hypotheses:

H1 Subjects who receive pre-instruction have better scores on a post test than subjects who do not receive pre-instruction.

H2 Subjects who receive pre-instruction have better scores on a retention test than subjects who do not receive pre-instruction.

H3 There is an interaction effect between 'presenting learning objectives' and 'locus of control (Tovar and Coldevin, 1992).

H4 Subjects in the FIXED condition score about as high or higher on a post test than subjects in the FREE condition (Verhagen, 1992; Breman, 1995).

H5 Subjects in the FIXED condition score higher on a retention test than subjects in the FREE condition (Verhagen, 1992; Breman, 1995).

H6 In the FREE condition, subjects who receive pre-instruction will, in general, choose shorter segment lengths than subjects who do not receive pre-instruction.

H7 Subjects who work through the experimental program in the pre-instruction condition show more intentional learning than incidental learning.

H8 Subjects who work through the experimental program in the no-pre-instruction condition perform worse on test items that relate to intentional learning than the pre-instruction group and perform better on test items that relate to incidental learning than the pre-instruction group.

For H6, segment length is not measured in time (as the number of seconds that a video segment runs), but is operationalised as the number of information elements that are contained in the segment. An information element is thereby defined as the smallest unit of meaningful information in the programme, which generally takes the form of one sentence spoken by the narrator with accompanying video images. The experimental section of the video disk program contains 216 information elements, distributed over 7 chapters. The mean segment length of each chapter is thus about 31 information elements. Compared to measuring segment length in time, in this case one information element has on the average a duration of about 8 seconds, yielding mean chapter lengths of about 4 minutes.

Method

Subjects

49 first-year students from two Agricultural Colleges in Velp and Leeuwarden in the Netherlands were the subjects. Their ages range from 18 to 22 years old. All students were prepared for college-level education by completing appropriate general or vocational programs in secondary school.

To determine the desired sample size, the guidelines by Neter, Wasserman and Kutner (1985) were used. To be able to test the hypotheses in this study at a level of significance with α=0.05 and a power of 1-β=0.80, at least 17 subjects should be selected for each factor and thus a minimum of 9 subjects per condition. This is based on a minimum difference Δ of 4 points between the means of the scores on the post test and the retention test. The maximum score of each test is 34 points. Further, the standard deviations of the scores on the post test and the retention test that were found by Breman (1995) were taken as a starting point. In April 1996, 40 students from the school in Velp put their names on a list to volunteer for the experiment. Participation in the experiment was an activity which was recognised as part of a project they were working on. Unfortunately, this activity was not strictly required and many students decided to spend their time on a different activity. In the end, only 24 subjects remained. To compensate for the loss of subjects, the experiment has been repeated in December 1996 in Velp, yielding 13 extra subjects, and in January 1997 in Leeuwarden, where 11 extra subjects participated. This time, the Velp group received 15 Dutch guilders (about $ 8.30) for their participation as a small incentive to encourage them to volunteer. The Leeuwarden subjects participating in the experiment were excused from an otherwise compulsory field trip. As all subjects were distributed randomly over the experimental conditions, it is assumed that the data of all three groups can be pooled without substantial loss of reliability.

Sessions

The experiment was administered in two sessions. In the first session, which took about two hours, the subjects worked with the experimental program and complete the post test. The second session took place between two and three weeks after Session 1, and is used to complete the retention test. This session takes about 30 minutes. The second Velp group had to complete the retention test at home during the Christmas holiday, when the school was closed. They sent the test forms back by prepaid mail. For logistic reasons, the Leeuwarden group also sent the test forms back by mail.

The first session took place in a classroom that was furnished for the occasion. Four sets of equipment were installed on tables along two walls. The minimum distance between the tables was two meters (about six feet) to ensure that each subject could work individually without being distracted by adjacent participants. Each set of equipment consisted of a computer with keyboard and mouse, a monitor, a video disk player, and an audio amplifier with headphones. The work of the subjects was monitored by one of the experimenters who had a table near the front of the classroom.

The second session took place in the same room where Session 1 took place (first group in Velp), at home (second group in Velp), or in a different classroom (group in Leeuwarden). While the capacity of Session 1 was four subjects at a time, the retention tests were administered in larger groups. The delay between post test and retention test could therefore differ from two to three weeks. The random assignment of subjects to conditions was, however, such that no undesired influence on the data analyses is expected. On the average, the period between Session 1 and Session 2 was two-and-a-half weeks.

The experimental video disk program

The experimental program that was used is a computer-controlled interactive video disk about the industrial process of cheese making. The video disk program is divided in chapters. There is a main program of seven chapters that is used for data collection (total running time: 31.5 minutes), preceded by an introductory chapter with a length of 4.30 minutes[1]. The introductory chapter gives an overview of the cheese making process, which is used to familiarise the subjects with their experimental task and to orient them on the content of the main program.

Conditions

The program was prepared to serve two conditions: FIXED and FREE. In the FIXED condition, the subjects worked through all seven chapters in a linear order. The program presents the first video chapter without interruption, followed by questions about this chapter. All questions are open questions that require a brief sentence, a word or a number as an answer. After answering all questions about the chapter, the answers to the questions are

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[1]) European interactive video disks use the PAL video format which has a frame rate of 25 fps. One side of a video disk in CAV mode counts 54,000 frames, thus yielding 36 minutes of running video.

reviewed one by one. Correct answers are reinforced by a feedback statement that also contains the full text of the answer. For missed questions a small piece of video is repeated and the question is posed for a second time. This time feedback is provided that tells what the right answer is irrespective of right or wrong. When all questions have been reviewed, the subject had no other choice than continuing with the next chapter. In this way the subject worked through all chapters. The subject only controlled the pace of the session by taking more or less time for answering questions or for taking a pause between chapters. In the FREE condition, the subject was free to select any order of the chapters and could also decide to answer questions immediately or later, or even before watching the related video material. When watching video, the subject in the FREE condition could interrupt the chapters as often as he or she wants. In that way, video segments were defined that are (much) shorter than the complete chapters. After each interruption, the program offered the option to answer questions about the segment just watched; or about the chapter as a whole. Whatever the subject decided, the review system after answering questions was always the same as described in the FIXED condition. In both conditions, a subject could only leave the program if all questions from the program had been answered. This means that all subjects answered all questions that are embedded in the program.

The FREE as well as the FIXED condition have been used in two versions to be able to research the effects of pre-instruction, resulting in four conditions in total: FREE with pre-instruction (FREE/P), FREE with no pre-instruction (FREE/NP), FIXED with pre-instruction (FIXED /P), FREE with no pre-instruction (FIXED /NP).

Subjects who worked in the FREE/P and FIXED /P conditions received a manual with learning objectives. In this manual, the objectives were specified per chapter of the video disk program. The subjects were allowed to study the manual before they started working with the program. They could consult the manual during the experiment as often as they want.

Tests, questionnaire and other material

The post tests and retention tests that were used in all conditions contained 34 multiple choice questions, each with four alternatives. For every question in the post test there was a parallel question in the retention test. This was done to avoid plain recall of answers between post test and retention test. The data that were collected by these tests, are used to test all hypotheses except hypothesis H6.

The tests were constructed using the questions that were used in the study by Breman (1995). For each test (the post test and retention test) 24 questions were taken almost verbatim from Breman, and 10 more questions were constructed in a similar style. The post test and retention test were nominally parallel. This means that empirical evidence for psychometric parallelism was lacking. The tests were, however, still completely similar.

The post test and retention test each consisted of two parts. One part (24 questions) was directly related to the learning objectives from the pre-instruction conditions. The answers to these questions are used to test hypotheses H1, H3, H4, and H7 (related to the post test) and H2, H3, H5, and H7 (related to the retention test). The other part (10 questions) was not related to these objectives. The objectives-related part was meant to measure intentional learning, the other part to measure incidental learning. The difference is used to test hypotheses H8 and H9. Table 1 helps to explain how intentional and incidental learning is operationalised in this study.

Table 1: Definition of relative scores Y1 to Y4 to test hypotheses H8 and H9

Pre-instruction by means of learning objectives:	relative score on 24 learning-objective related items	relative score on 10 non-learning-objective related items
Yes	Y1 (=abs.score/24)	Y2 (=abs.score/10)
None	Y3 (=abs.score/24)	Y4 (=abs.score/10)

To be able to compare the test scores for the 24 learning-objective related items with the test scores for the 10 non-learning-objective related items, the absolute scores are normalised by dividing the scores by the number of questions: 24 (yielding the factors Y1, Y3), respectively 10 (yielding the factors Y2, Y4) (Table 1). If pre-instruction has the predicted effect, Y1 should be larger than Y3 (Y1>Y3): subjects who received pre-instruction have higher scores for intentional learning than subjects who did not receive pre-instruction. The effect of pre-instruction is also expected to cause Y2 to be smaller than Y4 (Y2<Y4): subjects who received pre-instruction directed their

attention primarily to learning-objective related content and paid less attention to other parts of the subject matter. Subjects who did not receive pre-instruction are expected to pay equal attention to all subject matter. This equally distributed attention should cause Y3 to be equal to Y4 (Y3=Y4). Lastly, Y1 is expected to be larger than Y2 (Y1>Y2): directing attention to the learning-objective related content will yield a relatively better score on the 24 learning-objective related items in the tests compared to the 10 non-learning-objective related items. It is obvious that this reasoning only holds if the mean level of difficulty of the 24 learning-objective related items is equal to that of the 10 non-learning-objective related items. The experimental design attempts to account for this by randomly selecting the 10 items for which no learning objectives are presented in the pre-instruction from all 34 items in the test.

Directly after working with the program and before administering the post test, the subjects were asked to complete a questionnaire about the audio-visual qualities of the program, and their opinions about the program in general. This questionnaire was used to check whether the subjects were at ease when working with the program and did not encounter problems when using it.

Each subject receives four blank sheets of paper (A4 format) and a pen for note taking during the experiment. Further, a sheet with instructions for the subject is on each table in a version that fits the experimental condition of that subject.

Procedure

For this experiment a 2x2 factorial design was used with the factors pre-instruction and locus of control. The subjects were randomly assigned to the four conditions.

The answers of the subjects to the questions in the program were registered in a log file. In the FREE condition, the chosen segment lengths were also registered. The segment-length data are used to test H6.

Data collection took place according to the following procedure:

Session 1
Step 1 (Only in conditions FREE/P and FIXED/P:)
Reading the manual with the instructional objectives with the opportunity to ask the experimenter questions about the objectives.
Step 2 Practising with the instructional system while working through the introductory video chapter.
Step 3 Carrying out the experimental task.
Step 4 Completing the questionnaire about the audio-visual qualities of the program, and about working with the program in general.
Step 5 Completing the post test. (End of Session 1.)

Session 2
Step 6 After about two-and-a-half weeks: completion of the retention test.

Results

The results of the experiments are as follows. Table 2 shows the mean scores on the total post test of 34 items, the standard deviations and the number of observations per condition. Table 3 shows the same data for the retention test. In both tables, the numbers between brackets show the data for the subset of 24 learning-objective related items.

Table 2: Post test results for mean (M), standard deviation (SD) and number of observations (n)

	Condition		
	FIXED (computer control)	FREE (learner control)	Total
Pre-instruction	M=28.58 (19.83) SD= 1.88 (1.85) n=12	M=26.38 (18.69) SD=3.28 (2.81) n=13	M=27.44 (19.24) SD=2.87 (2.42) n=25
No pre-instruction	M=27.53 (18.47) SD=2.20 (1.30) n=15	M=26.36 (18.27) SD=2.29 (1.85) n=11	M=27.04 (18.38) SD=2.27 (1.52) n=26
Total	M=28.00 (19.07) SD=2.09 (1.68) n=27	M=26.38 (18.50) SD=2.81 (2.38) n=24	M=27.24 (18.80) SD=2.57 (2.04) n=51

Between brackets: Data for the subset of 24 learning-objective related items.

Table 3: Retention test results for mean (M), standard deviation (SD) and number of observations (n)

	Condition		
	FIXED (computer control)	FREE (learner control)	Total
Pre-instruction	M=20.70 (14.10) SD=4.71 (3.87) n=10	M=19.27 (13.27) SD=3.58 (2.80) n=11	M=19.95 (13.67) SD=4.12 (3.29) n=21
No pre-instruction	M=21.33 (14.58) SD=3.45 (2.15) n=12	M=20.56 (13.89) SD=5.03 (4.11) n=9	M=21.00 (14.29) SD=4.10 (3.07) n=21
Total	M=21.05 (14.36) SD=3.98 (2.98) n=22	M=19.5 (13.55) SD=4.22 (3.36) n=20	M=20.48 (13.98) SD=4.09 (3.16) n=42

Between brackets: Data for the subset of 24 learning-objective related items.

Table 4 shows the results of a two-way analysis of variance of the data. The results show a significant main effect for locus of control for the complete post test with a level of significance of .020: Subjects in the FIXED condition performed better than in the FREE condition. The related effect size is 1.62 points on a scale of 34 points or 4.8 percent. These results confirm H4. No further significant effects appeared to occur, which means that there is no sufficient evidence to support H1, H2, H3, and H5.

Table 4: ANOVA results for the post test and the retention test

	MS		F	Significance of F
Post test:				
Main effect for locus of instructional control	35.518 (5.541)	1	5.791 (1.368)	0.020 (0.248)
Main effect for pre-instruction	4.021 (10.679)	1	0.656 (2.637)	0.422 (0.111)
Interaction effect	3.332 (2.822)	1	0.543 (0.697)	0.465 (0.408)
Retention test:				
Main effect for locus of instructional control	12.687 (6.019)	1	0.729 (0.573)	0.399 (0.454)
Main effect for pre-instruction	9.239 (3.108)	1	0.531 (0.296)	0.471 (0.590)
Interaction effect	1.095 (0.046)	1	0.063 (0.004)	0.803 (0.948)

Between brackets: Data for the subset of 24 learning-objective related items.

To test whether subjects in the FREE/P condition choose shorter video segments than in the FREE/NP condition, a t-test for independent samples was used. Table 5 shows that there are no significant differences for self-chosen segment length, which yields no support for H6. Given the fact that the mean segment length in the FIXED condition is 30.86 information elements, Table 5 also shows that the subjects decided, on the average, for segments that are about 80 percent of the length of the pre-defined chapters. A closer look at the data reveals that only 3 subjects divided the segments into very small portions (with an average length of about 10 information elements), while the mean segment length of the remaining group is 26.65 information elements or 86% of the maximum possible mean segment length (Figure 1).

*Table 5: T-test for differences in mean self-chosen segment length**

	n	M	SD	d.f	t-value	p-value
Pre-instruction	13	24.58	5.74	14.79	.16	.875
No pre-instruction	10	24.07	8.71			

*: Segment length was measured as a number information elements, see text next to the list of hypotheses.

The questionnaire that was administered just after working with the program and before the post test yielded, in general, positive results about the appreciation of the audio-visual and interactive qualities of the program.

Table 6 and Table 7 show whether differential results occurred with respect to intentional and incidental learning, both for the post test and the retention test. Table 6 compares differences in intentional and incidental learning between the pre-instruction and no-pre-instruction conditions. Table 7 compares intentional and incidental learning within the pre-instruction and no-pre-instruction conditions. Only Table 7 shows a significant result: Subjects in

the no-pre-instruction condition performed better ($p<.001$) on the 10 test items that relate to incidental learning for the pre-instruction group (with a mean score of 86 percent, see Table 6) than on the 24 items that relate to intentional learning of the pre-instruction group (with a mean score of 77 percent). This means that neither H7 or H8 are supported, while the reported significant effect was not expected.

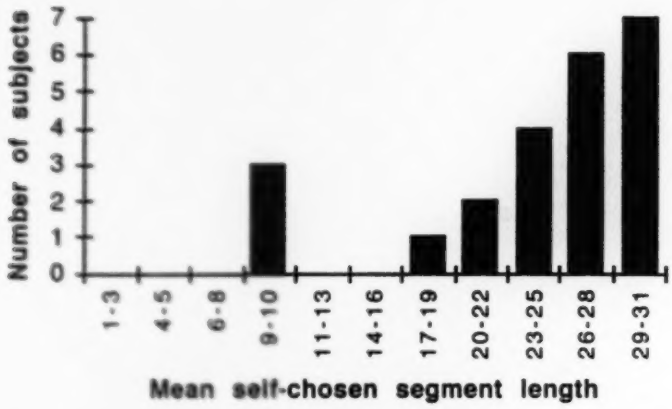

Figure 1: Distribution of self-chosen segment length in the FREE condition.

Table 6: T-tests for differences between Y1 and Y3 and for Y2 and Y4 for post test and retention test

		Variable	n	M	SD	d.f	t-value	p-value
Difference post test	Y1/Y3,	Y1	25	.802	.101	40.20	1.50	.141
		Y3	26	.766	.064			
Difference post test	Y2/Y4,	Y2	25	.820	.126	48.99	-1.27	.210
		Y4	26	.865	.129			
Difference retention test	Y1/Y3,	Y1	21	.569	.137	39.80	-.63	.532
		Y3	21	.595	.128			
Difference retention test	Y2/Y4,	Y2	21	.614	.139	36.87	-1.12	.269
		Y4	21	.671	.187			

Table 7: T-test for differences between paired samples Y1 and Y2 and Y3 and Y4 for post test and retention test

	n	M	SD	df	t-value	p-value
Y2-Y1; post test	25	.0183	.150	24	.61	.548
Y4-Y3; post test	26	.0994	.126	25	4.01	.000
Y2-Y1; retention test	21	.0448	.113	20	1.83	.083
Y4-Y3; retention test	21	.0762	.188	20	1.86	.078

Discussion

The results of the study show a significant result for locus of control. Subjects in the FIXED condition, in which the order and length of video segments was controlled by the computer, performed better on the post test than in the FREE condition, in which they were allowed to interrupt video segments as often as they wanted and in which they were free to go through the material in any order (Table 4). The effect size of 1.62 points (Table 2) on a scale of 34 points or 4.8 percent is, however, not impressive. Still, this result is in line with findings by Breman (1995), who also obtained a small but significant difference in test performance between a free and a fixed condition in favour for the fixed condition.

Breman used the same video disk and the same computer program to control it in a pre-test post-test design. In Breman's case, the mean of mean self-chosen segment length in his free condition was 21.55 Information Elements (in time: about 3 minutes). This led to the reasoning that the longer segments of the fixed condition yielded better results because longer watching is a more difficult task, and that the subjects were sufficiently aware of this to decide to invest a greater amount of mental effort (AIME: Salomon, 1984) than in the case of the free condition where the subjects could interrupt whenever they felt like it. These results were similar to the results of Verhagen (1992b). Also Verhagen found that forced exposure to of relatively long segments supports the learning of factual information.

In the present study, however, the differences between mean self-chosen segment length and the mean segment length in the FIXED condition are rather small (Figure 1). An alternative explanation should be considered. It could be that the freedom of selecting the order and length of video segments in the FREE condition formed a burden for the subjects, who were aware of the need to make decisions by themselves all the time, while the subjects in the FIXED condition could concentrate on the content of the programme, guided by the computer. Further research around the AIME concept is recommended, to try to find an answer to this problem.

Table 7 shows the unexpected effect that subjects in the no-pre-instruction condition performed better on test items that relate to incidental learning in the pre-instruction condition than on test items that relate to intentional learning in the pre-instruction condition. Without the orienting objectives from the pre-instruction, no differences in performance should be expected. It is a fact that the 10 questions for incidental learning were constructed for this experiment, while the other 24 questions were already there from the experiments by Breman. Although no cues in this respect were initially there, it still could be the case that the difficulty level of the 10 questions is lower than the difficulty level of the other questions. If that should be true, then the fact that in the pre-instruction condition no differences were found should be an indication in favour of H7. As things are now, no possibilities exist to arrive at a clear conclusion about the use of pre-instruction.

The fact that pre-instruction makes no difference may, however, also be caused by the quality and structure of the audiovisual program. It is possible that the structure and the clear presentation of the audio-visual material and the questions of programme overruled the effects of pre-instruction (Mayer, 1979; Hannafin, Phillips, Rieber, Garhart, 1988).

In all, only one main effect results: In this study, program-control yielded a better post test performance that learner control, although the effect size is rather small. Given similar results by Breman (1995), Verhagen and Breman (1995), Verhagen (1992), and Zijderveld (1991), it can be recommended that for learning factual information it seems to be a matter of taste and contextual conditions whether program-controlled or learner controlled interactive programs should be used. And if all other things were equal, the easier (and thus cheaper) to be produced program-controlled programs could be preferred.

As an explanation, it could be argued that if the audio-visual presentation is a clear story, maybe the learner control options are just a burden to the learners. Clarity may also cause the limited need for selecting short

segments, as appeared from the data. (Figure 1).

It should be noted that in this research and in other research mentionend, the subject matter is about factual information only. Still, it seems warranted to recommend the following for future reseach:

May be it is time to revive the attention for story-based media, to balance the overwhelming attention currently given to interactive media.

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